CLAIMS

1. A method of monitoring a sample containing a neutron source in which:

i) signals from a plurality of neutron detectors are analysed and the count rates for single, double and triple incidence of neutrons on the detectors are determined;

ii) the single, double and triple count rates are equated to a mathematical function related to the spontaneous fission rate, self-induced fission rate, detection efficiency and α,n rate;

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iii) a probability distribution is assigned to each of the self-induced fission rate, detection efficiency and α,n reaction rate and each of the counting rates to provide a probability distribution factor for any given value;

iv) and the value of the product of all the probability distribution factors is increased to give an optimised solution and so provide a value for the spontaneous fission rate which is linked to the mass of the neutron source.

2. A method according to claim 1 in which the signals comprise a series of pulses, each pulse causing a time period to be considered, with other pulses being received in that period being associated with the initial pulse, the number of pulses in the sequence giving the single, double, triple and greater numbers of neutron counts.

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*3. A method according to claim 1 wherein the singlet count rate is related to the spontaneous fission rate, the self-multiplication factor, where

$$m = \frac{1-p}{(1-p)\upsilon_I}$$

and p = probability first neturon causes induced fission, the detection efficiency and the α,n reaction rate by the function,

$$R_1 = \epsilon . F_s . M . v_{s1} . (1+\alpha)$$

* 4. A method according to claim 1 in which the doublet counting rate is related to the spontaneous fission rate, the self-multiplication factor, where

$$m = \frac{1-p}{(1 - p)\upsilon_I}$$

and p = probability first neutron causes induced fission; the detection efficiency and the α,n reaction rate by the function

$$R_2 = \varepsilon^2 \cdot F_s \cdot M^2 \cdot \nu_{s2} \cdot \left(1 + (M-1)(1+\alpha)\frac{\nu_{s1}\nu_{I2}}{\nu_{s2}(\nu_{I1}-1)}\right)$$

* 5. A method according to claim 1 wherein the triplet counting rate is related to the spontaneous fission rate, the self-multiplication factor, where

$$m = \frac{1-p}{(1 - p)\upsilon_I}$$

and p = probability first neutron causes induced fission; the detection efficiency and the α,n reaction rate by the function

$$R_3 = \varepsilon^3 \cdot F_s \cdot M^3 \cdot \nu_{s3} \cdot \left(1 + 2(M-1)\frac{\nu_{s2}\nu_{I2}}{\nu_{s3}(\nu_{I1}-1)} + (M-1)(1+\alpha)\frac{\nu_{s1}\nu_{I3}}{\nu_{s3}(\nu_{I1}-1)}\left(1 + 2(M-1)\frac{\nu_{I2}^{2}}{\nu_{I3}(\nu_{s1}-1)}\right)\right)$$

* 6. A method according to claim 1 in which the probability distribution assigned to individual variables or counting rates is a normal distribution or a flat distribution or a triangular distribution.

7. A method according to claim 6 in which a normal distribution is used for one or more, and most preferably all, the counting rates.

*8. A method according to claim 6 in which triangular distributions are used for one or more, and most preferably all, the individual variables, such as detector efficiency, fission rate, multiplication distribution and alpha distribution.

*9. A method according to claim 6 in which a flat distribution is used for the fission rate.

*10. A method according to claim 6 in which the distribution(s) are constrained within certain applied constraints/boundaries, such that the probability distribution factor is zero beyond the constraints or such that the probability distribution factor rapidly tends to zero beyond certain values.

*11. A method according to claim 6 in which one or more of the constraints are set according to information gathered from a preceding isotopic consideration or analysis of the sample.

*12. a method according to claim 6 in which the increasing, and preferably maximisation, of the product of the probability distribution factors (pdf's) is preferably performed as an iterative process.